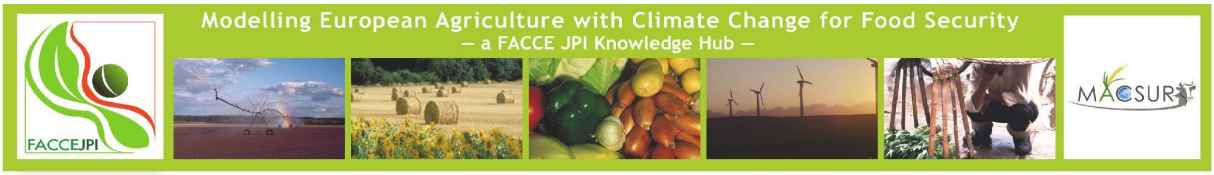


# Workshop on Regional Pilot Studies

## 5-7 June 2013, Braunschweig

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|---|---|
| Instrument: | Joint Programming Initiative |
| Topic: | Agriculture, Food Security, and Climate Change |
| Project: | Modelling European Agriculture with Climate Change for Food Security (FACCE-MACSUR) |
| Due date of deliverable: | — |
| Submission date: | 2013-06-20 |
| Start date of project: | 1 June 2012 |
| Duration: | 36 months |
| Theme, Work Package: | Hub 1 |
| Deliverable lead partner: | University of Reading/Thünen Institute |
| Deliverable reference num.: | — |
| Deliverable type: | Workshop |

| Revision | Changes | Date |
|---|---|---|
| 0.1 | Draft | 2013-06-13 |
| 0.2 | Section on SSPs corrected (F. Piontek) | 2013-06-13 |
| 0.3 | Added discussion on RAPs and baseline scenarios and short section on TradeM roundup (Franz Sinabell) | 2013-06-14 |
| 0.4 | Added link to GIS and information on data adapter (M. Köchy, J. Jorgenson) | 2013-06-14 |
| 0.5 | Revised section on comparisons necessary for assessment of future conditions (M. Köchy) | 2013-06-17 |
| 0.6 | Revised section on comparisons necessary for assessment of future conditions (A. Zimmermann) | 2013-06-19 |
| 1.0 | Released version | 2013-06-20 |

## Abstract/Executive summary

The workshop was called to define an overarching question to be answered by all Regional Pilot Studies and to select from the existing studies those that fit best to the aims of MACSUR. The question that evolved from the discussions is “What would be the different contributions of different European adaptation strategies to ensure global food security until 2050 at different scales (farm to EU) while keeping the GHG targets?” Workshop participants agreed to use the newest climate simulations related to Representative Concentration Pathways that were also used by the AgMIP and ISI-MIP projects. There was also agreement to use a subset of the AgMIP scenarios (S2-S6) for impact assessments, with AgMIP scenario S1 as the reference scenario, for details see Table 3 below. The selection of Regional Pilot Studies was discussed separately for European Grand Regions, but there was no concluding decision taken. The Project Steering Committee will finally decide on showcase studies at a meeting in the first week of July based on characterisations sent in by interested members. Questionnaires for characterising the Regional Pilot Studies will be sent by the Hub to the regional contact persons mentioned in Table 2 to fill in. The characterization list can be extended. The questionnaires should be filled in by the end of June. Stakeholder meetings are planned for October 2013 in each region where preliminary/sample outputs of the regional pilot studies should be presented. Results will be presented at the mid-term meeting in April 2014. The last year of MACSUR is then available to improve the studies.The geographic extent of the Regional Pilot Studies is approximately county level – representing the area of the studies they are based on. The Regional Pilot Studies will be linked within the grand regions (northern, central, southern Europe) by consistent regional and continental Representative Agricultural Pathways (RAP). These regional RAPs will feed into the RAP process underway at AgMIP. Through the common RAPs the Regional Pilot Studies will reflect the common challenges of the greater region and by having several Regional Pilot Studies the diversity of the environment, farming systems, and political systems is represented. The workshop was a first step into further planning and performing the Regional Pilot Studies that will fine-tune the results of the workshop.

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## Introduction

FACCE MACSUR was initiated to assess the impact of change in a) global crop production and b) food demand outside Europe on farms and farming, food production, and food prices in Europe and selected European regions. This medium-term analysis will based on models, including quantification and expression of uncertainty in each modelling step. Furthermore the project will identify based on the assessment the opportunities or urgent needs for concerted European actions regarding contributions to global food security. MACSUR takes a four-step approach in assessing the impact of climate change on food security. 1. Inventory of data sets and models; benchmarking and improvement of models; ensemble model runs 2. Advancement across two Themes tested on Methodological Case Studies 3. Questions of impact answered by Regional Pilot Studies across three themes 4. Scenarios defining boundary conditions for all Themes and Studies (Fig. 1).

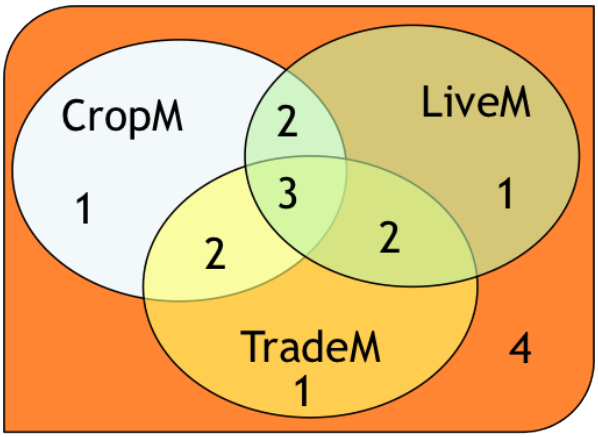


Fig. 1. The approach of impact assessment in MACSUR.

The purpose of the Regional Pilot Studies is a simultaneous and interlinked development of a common conceptual framework and actual models and model links. The overall aim of MACSUR is to assist policy makers and actors in the agri-food chain in identifying effective and efficient adaptation and mitigation measures and potential consequence scenarios, e.g. impact on food yield, quality, nutritive value, disease load etc. in perceived hotspots of climate impacts.

The workshop aimed at agreement across Themes on

- specific questions to be answered by Regional Pilot Studies,
- an agreement on joint scenarios and joint locations of regional pilot studies,
- procedures for data exchange, timing, scaling, assessment, reporting.

## Information

The flow of information from General Circulation Models/Global Climate Models (GCMs) to local weather scenarios was presented by Mikhael Semenov (Rothamsted Research). Different GCMs and different methods for scaling exist from coarse GCM outputs to finer regional outputs. Stochastic regional weather generators are especially useful for producing long time series for assessing the effects of weather variability or likelihood of severe weather impacts in a single location. Other approaches must be used for addressing climate impacts related to area, e.g. droughts across larger regions or killing frosts in several locations simultaneously. Weather simulations exist for a wide range of combinations of GCMs and regional downscaling for the $CO_2$ emission scenarios used up to the fourth IPCC report (IR4). These $CO_2$ emission scenarios are characterized by codes like A2, B2, A1B and indicate emissions that were deemed probable under certain future socioeconomic developments (SRES scenarios) and were associated with specific atmospheric $CO_2$ concentrations that drive global warming.

For the latest comparison of GCMs (CMIP5), a different approach —Representative Concentration Pathways (RCPs)— was chosen. RCPs assume different levels of radiative forcing (2.6, 4.5, 6.0, 8.5 W/m$^2$) in the year 2100 that are more closely correlated with global warming (Fig. 2). The lowest level of radiative forcing will likely result in a mean global temperature increase of 1.3 °C in 2100, whereas a radiative forcing of 8.5 W/m$^2$ will likely result in an increase of 4.4 °C (Tisdale, 2012). Global simulations and regionally downscaled simulations currently exist for several combinations of GCMs linked to various downscaling methods, but no stochastic regional weather generators exist yet. In contrast, simulations and stochastic weather generators exist for a much larger number of combinations of GCMs, downscaling methods, and emissions scenarios. The workshop participants agreed after a discussion to adopt the new RCPs.

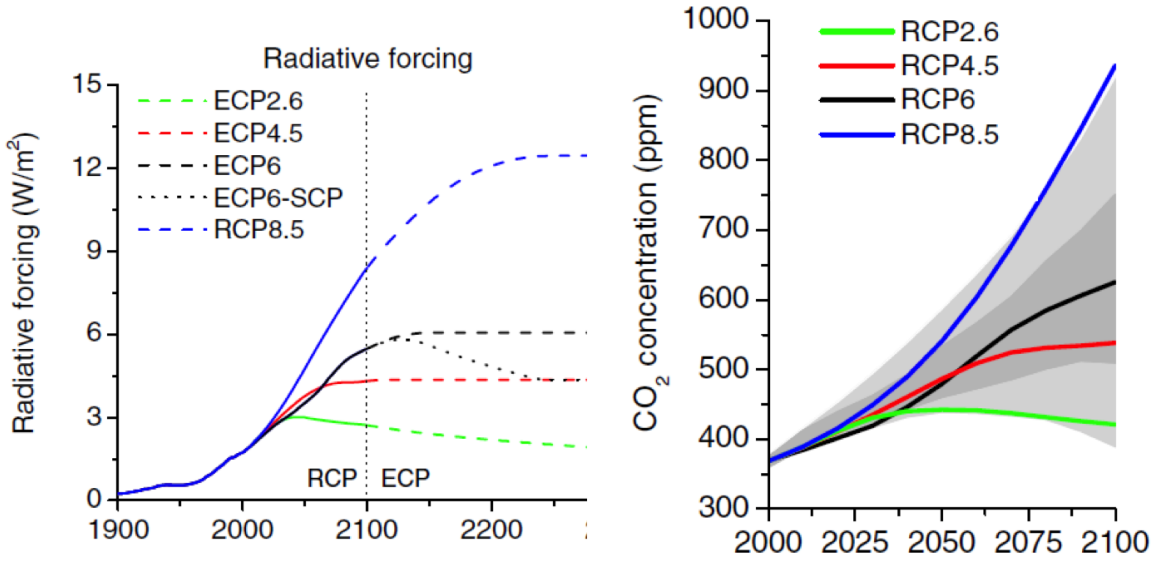


Fig. 2. Relationship between global atmospheric $CO_2$ concentration and radiative forcing characterized by Representative Concentration Pathways (RCPs) and extended Concentration Pathways (ECPs). (Contributed by M. Semenov.)

RCPs are associated with socioeconomic scenarios (Shared Socio-economic Pathways, SSPs), that explain the level of radiative forcing. Different SSPs can be associated with one RCP depending on the kind of projected climate policies (Shared climate Policy Assumptions, SPAs, Edenhofer et al. 2012). Five different groups of SSPs (across SPAs) have been described so far and have been ordinated along the two axes of fossil energy and resource use intensity on the one hand side and socioeconomic development on the other side (Fig. 3). The SSPs in each group are characterized by the phrases (1) Sustainability, (2) Continuation, (3) Fragmentation, (4) Inequality, and (5) Conventional development).Some combinations of SSPs with RCPs are inconceivable (Fig. 4).

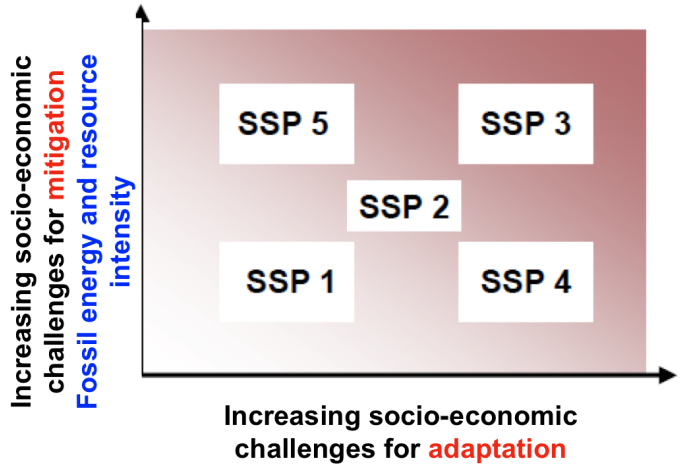


Fig. 3. Groups of Shared Socioeconomic Pathways (SSPs) within a range of socio-economic challenges for mitigation and adaptation. (Contributed by F. Piontek, PIK)

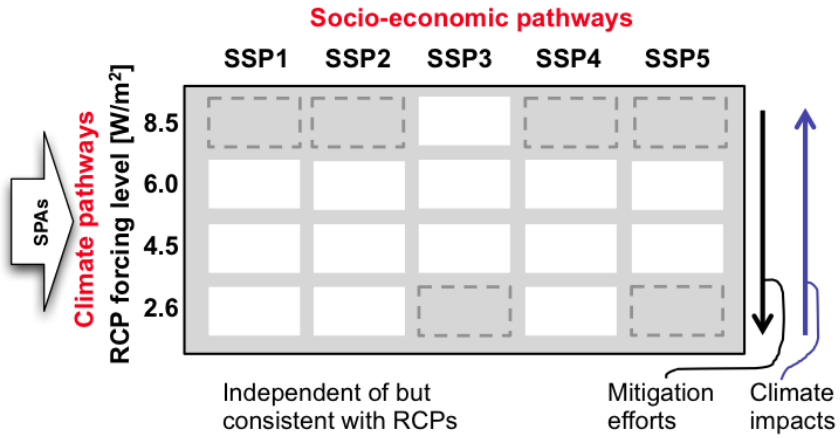


Fig. 4. Different Shared Socieeconomic Pathways (SSPs) can explain different levels of radiative forcing in the Representative Concentration Pathways (RCPs) depending on the assumed future climate policies (SPA). (Adapted from F. Piontek, PIK, and Tom Kram, PBL)

SSPs are characterized by a catch phrase (see above), a narrative, quantitative population and Gross Domestic Product (GDP) scenarios, quantitative elements coming from Impact Analysis Models (IAM), and other quantitative elements (e.g. ecosystem productivity). Narratives and quantitative population/GDP scenarios are available from IIASA upon request. As an example, SSP2 (catch phrase "Continuation") represents medium challenges and continuation of current trends:

- Slowly decreasing fossil fuel dependency
- Reductions of resource and energy intensity
- Uneven development of low-income countries
- Few weak global institutions
- Slow continuation of globalization with some barriers remaining
- Well regulated information flow
- Medium economic growth, slow convergence
- High intra-regional disparities
- Medium population growth related to medium educational investments
- Delay of achievement of MDGs;

whereas SSP3 (catch phrase "Fragmentation") represents high challenges and global socio-economic fragmentation:

- Regions of extreme poverty, pockets of moderate wealth, bulk of countries struggling to maintain living standards for strongly growing population
- Little coordination between regional blocks of countries
- Energy and food security within regions
- De-globalization, severe restrictions on international trade
- Little international cooperation
- Low investments in technology development and education
- High population growth , low economic growth
- Lack of governance and institutions.

SSPs contain also coarse assumptions (like ‘strong’, ‘medium’, ‘weak’) about fossil energy supply, energy demand, energy conversion, and land use and agriculture (Tab. 1) with associated storylines. The storylines for “Agriculture and land use” of SSP 2 assume incomplete regulation of land use, slow decline in tropical deforestation, slow increase of crop yields, medium calorie consumption, regionalization of trade, whereas those of SSP3 assume no regulation of land use change, decline of crop yield increase rates (little investment), high animal shares in diets, large waste, regionalized world (local food security).

Tab. 1. Indicators of land use and agriculture development in the SSP groups. (Contributed by F. Piontek, PIK).

| SSP element | Country income groupings | SSP1 | SSP2 | SSP3 | SSP4 | SSP5 |
|---|---|---|---|---|---|---|
| | Low | | | | Weak | |
| **Land use change regulation** | Med | Strong | Medium | Weak | Medium | Medium |
| | High | | | | Strong | |
| | Low | Rapid | | | Slow | |
| **Land productivity growth** | Med | Rapid | Medium | Slow | Medium | Rapid |
| | High | Medium | | | Rapid | |
| **Environmental impact of food consumption** | Med | Low | Medium | High | Medium | High |
| | Low | | | | Limited access | |
| **International trade** | Med | Globalized | Regionalized | Regionalized | Globalized | Globalized |
| | High | | | | Globalized | |

The “basic” SSPs that are intended for all sectors at the global level can be refined for specific regions, specific economic sectors (“extended SSPs”). One extension are

Representative Agricultural Pathways (RAPs) which are further refined to regional Representative Agricultural Pathways (rRAPs) (Fig. 5).

Representative Agricultural Pathways

- include assumptions consistent with the associated SSP about pathways of farming management development and adaptation capabilities,
- are consistent across climate, economics and field level farming management practices,
- describe synergies and trade-offs between biophysical and social dimensions of global food production,
- can be translated into scenarios of farming intensification levels and world agricultural trade policies to meet future food demand.

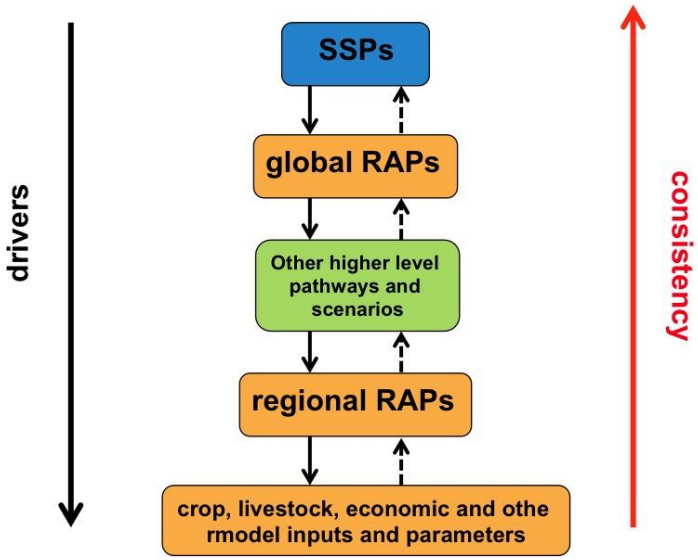


Fig. 5. Cascade from global SSPs to regional RAPs. (Contributed by F. Piontek, PIK).

Global RAPs have been developed by AgMIP (Antle et al. submitted) (Fig. 6). MACSUR has the expertise and capability for developing an overarching regional RAP for Europe and subregional RAPs for grand regions (e.g. northern, central, southern) within Europe. These lead the way for the development of regional RAPs for other parts of the world.

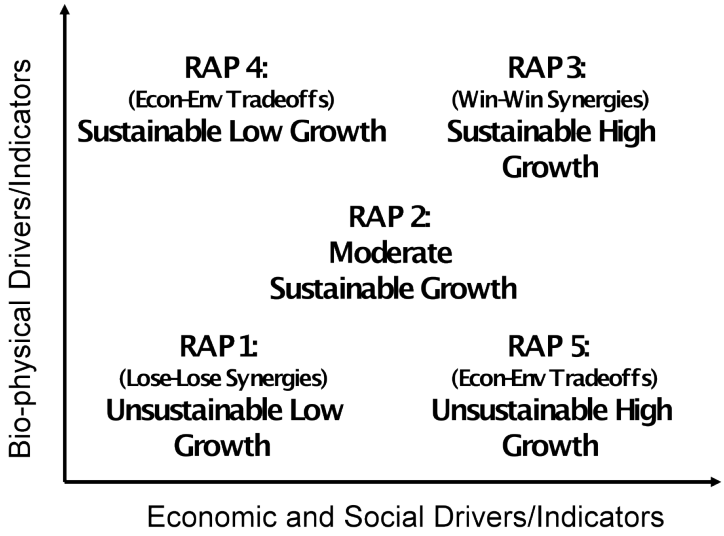


Fig. 6. RAP matrix in line with the SSP matrix (Fig. 2). (Contributed by F. Piontek, PIK).

## Focus question

Workshop participants agreed on a focus question that all Regional Pilot Studies should contribute to answer. **What would be the different contributions of different European adaptation strategies to ensure global food security until 2050 at different scales [farm to EU] while keeping the GHG targets?**

## Regional Pilot Studies

Regional pilot studies should fulfill the following criteria according to the proposal:

- different regions (and Europe as a whole) where the consequences of climate change are felt and/or where we can identify mitigation potential and promising adaptation strategies (aka 'hotspots')
- high degree of reflecting climate change
- adequately and consistently addressing uncertainty in climate change modelling
- high level of integration (like a tool)
- addressing stakeholder issues of adaptation, mitigation, maintain or increase food yield, quality, nutritive value, disease load, low-carbon economy, implementation of climate change mitigation policies
- incorporating natural resources (e.g. water and soils)
- reflecting the diversity of European farming systems

Workshop participants gathered in small groups representing three 'grand regions' of Europe: northern, central, and southern to identify existing impact studies, specific issues with respect to food production and climate change, the farm types covered, available models, general adaptation measures, and potential stakeholders. One to three existing impact studies were represented by persons in each 'grand region'. Gaps were apparent for western regions in northern, central, and southern Europe, and eastern southern Europe where impact studies with involvement of MACSUR members are known to exist (Fig. 7, Tab. 2). Therefore members in those areas will be contacted and invited to contribute

to Regional Pilot Studies. A geographical overview of locations of contributors of existing case studies is available from http://qgiscloud.com/macsur/macsurCloud.

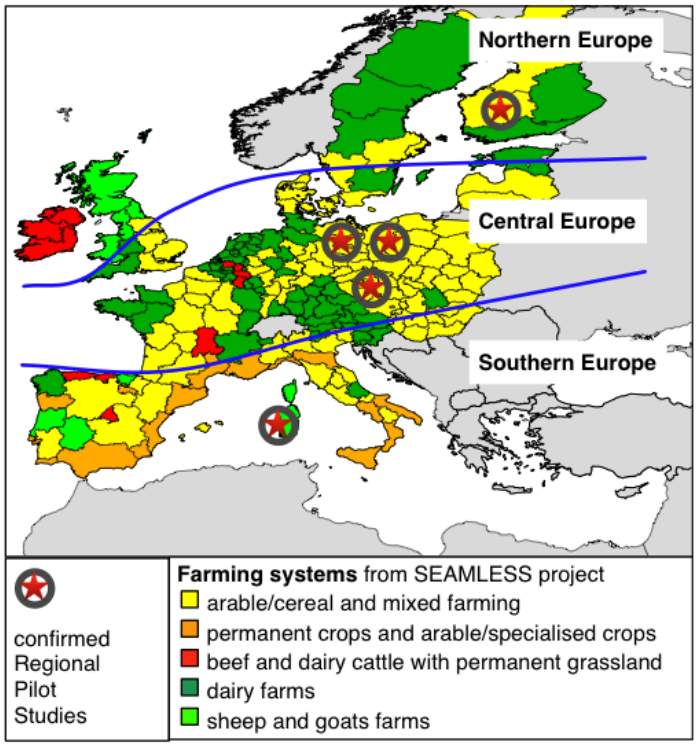


Fig. 7. Indicative location of 'grand regions' for Regional Pilot Studies.

Table 2. Countries of confirmed [or suggested] Regional Pilot Studies, with contact persons.

- Northern Europe
  - Finland (Heikki Lehtonen)
  - Norway (Klaus Mittenzwei)
  - [Sweden (Heikki will contact)]
- Central Europe
  - Germany [Brandenburg] (Peter Zander)
  - Poland (Waldemar Bojar)
  - Austria (Martin Schönhart)
  - [France (Gianni Bellocchi will contact)]
  - UK (Eric Audsley/Eli Sætnan)
- Southern Europe
  - Italy [Oristano, Sardinia] (Pier Paolo Roggero)
  - [Israel (Uri Mingelgrin tbc)]
  - [Spain (Martin B. will contact)]
- Pan-European studies
  - inventory of planned studies (co-ordinated by Floor Brouwer)
- Africa
  - European contribution (co-ordinated by Floor Brouwer)

Assessments of future conditions were suggested to be carried out at least for the periods 2020 [e.g. average of 2015-2025], 2030 [e.g. average of 2025–2035], and 2050 [e.g. average of 2045-2055]. Additional periods can be examined in the Regional Pilot Studies. For the assessment of adaptation needs with respect to one future period four scenarios

will be considered: a reference scenario (continuation of present trends into the future), a scenario based on climate change and continued present socioeconomic trends to isolate the impact of climate change, a scenario with present climate and potential socioeconomic changes to isolate the effect of a changed socio-economy, and a scenario including both climate and socio-economic change (Fig. 8).

Table 3 shows a subset of the scenarios used in the AgMIP project so far. Reference scenario S1 is a projection of present climate and socioeconomic trends into the future. Workshop participants agreed to use this scenario (also used by ISI-MIP) as reference scenario for MACSUR. Scenarios S2 to S6 provide alternative pathways to be compared to the reference scenario. Two optional pathways have been considered in AgMIP: one referring to socioeconomic changes and one to climate change. AgMIP scenario S2 provides simulations based on socioeconomic changes according to SSP3 and climate effects as in the reference scenario. AgMIP scenarios S3-S6 hold socioeconomic trends fixed (i.e. equal to the trend projections in the reference scenario) and vary referring to climatic conditions represented by RCP8.5. Scenarios S3-S6 differ in the combination of climate and crop growth models they are based on (Table 3). A 'worst case scenario' varying both socioeconomic trends and climate change (SSP3 + RCP8.5) is not part of AgMIP. For model intercomparisons a common dataset from the AgMIP scenarios (S4: SSP2, RCP8.5, GCM: HadGEM2-ES, vegetation model: LPJmL) will be used in MACSUR.

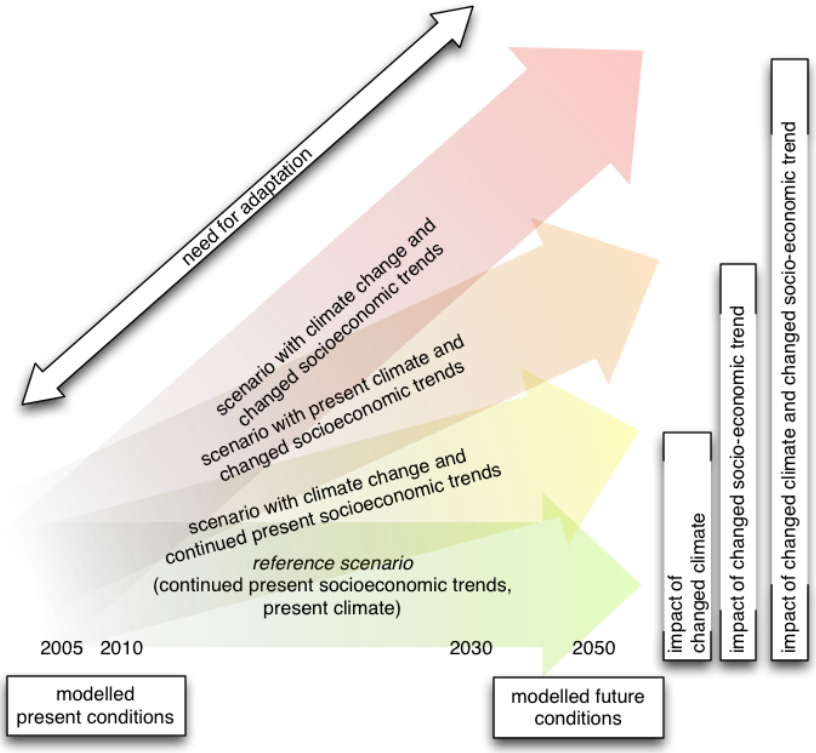


Fig. 8. Concept of scenarios (projections of trends) for use in comparisons to assess impacts in the future.

Table 3. AgMIP scenarios (von Lampe et al., in review)

| Scenario code | SSP | RCP | GCM | Crop model |
|---|---|---|---|---|
| S1 | SSP2 | Present climate | None | None |
| S2 | SSP3 | Present climate | None | None |
| S3 | SSP2 | RCP8.5 | IPSL-CM5A-LR | LPJmL |
| S4 | SSP2 | RCP8.5 | HadGEM2-ES | LPJmL |
| S5 | SSP2 | RCP8.5 | IPSL-CM5A-LR | DSSAT |
| S6 | SSP2 | RCP8.5 | HadGEM2-ES | DSSAT |

There was some discussion on the question how RAPs are going to be developed. Several workshop participants contributed to this discussion. The agreement finally reached was that RAPs will be developed in a bottom up effort. Partners involved in the Regional Pilot Studies will have to specify the details of assumptions because they are aware of the site or region-specific conditions. While the reference scenario will enter the Regional Pilot Studies in a top-down manner, the specific implementation has to be carried out in a manner that considers local conditions. The RAPs within MACSUR will therefore be developed in a bottom up process taking on board as much local knowledge as possible.

## Data coordination

Models often employ idiosyncratic formats and orders in their input and output of data. To facilitate the 'translation' of data Jason Jorgenson is developing software that acts as an adapter which will run on all major computing platforms. The software also contains the metadata (description) of existing databases so that modellers can use it to extract and further compile data produced by other models.

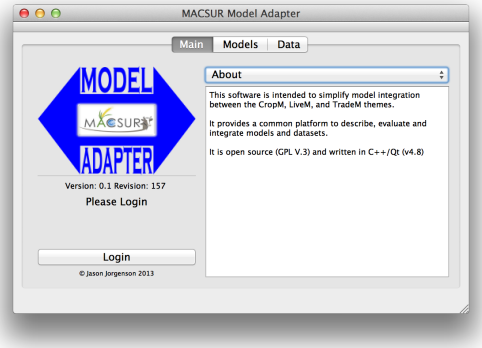


Fig. 9. Screenshot of Model Adapter.

This open source software, called MACSUR's **MAD** (**M**odel **AD**apter), is being written in C++/Qt with maximum flexibility for the future course of development in mind. The source code is available online.

## Break out session: TradeM round table discussion

One session was devoted to theme specific discussions for TradeM. Approximately 20 persons attended the meeting and partners from other themes also participated. A protocol of this meeting has been made available to all TradeM partners and the hub management team. It is available in the password protected partner area of TradeM at www.macsur.eu.

## Next steps

Leaders of selected and suggested Regional Pilot Studies (RegioPS) are expected to describe their studies by the end of June 2013 using a questionnaire developed jointly by Hub and leaders of RegioPS. Regional Representative Agricultural Pathways must be developed by September 2013. These and sample output of the RegioPS will be presented to stakeholders at regional workshops in October/November 2013 for discussion and adjustment of rRAPs, prioritizing of output variables and forms of output. Results should be presented at the MACSUR mid-term meeting in April 2014. The last year of MACSUR will be used to refine the RegioPS.

Table 3. Schedule for Regional Pilot Studies (RegioPS)

| | |
|---|---|
| June 2013 | RegioPS descriptions sent to Hub (M. Köchy) |
| Sept. 2013 | Representative Agricultural Pathways developed (RegioPS leaders, Hub) |
| Oct. 2013 | regional Stakeholder meetings |
| Apr. 2014 | results presented at Mid-term meeting |
| Apr. 2015 | refined results presented at Science Conference and Stakeholder Congress |

## Conclusions

The meeting has been a "break-through" for clarification where Regional Pilot Studies will be carried out and who will be responsible. The workshop was a first step into further planning and performing the Regional Pilot Studies that will fine-tune the results of the workshop. The overarching development of Representative Agricultural Pathways for linked models in Regional Pilot Studies will introduce a tangible contribution to the international endeavours of assessing impacts of climate change on food security.

## Acknowledgements

The workshop was supported with funding from The Norwegian Research Council which supports MACSUR with funding for joint workshops, the Norwegian consortium of Bioforsk, NILF and UMB, Thünen Institute, and BMBF grant 031A103A.

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Edenhofer et al. (2012) IPCC Workshop on Socio-Economic Scenarios, 1-3 November 2010. Berlin

von Lampe, M. et al. (in review) Why Do Global Long-term Scenarios for Agriculture Differ? An Overview of the AgMIP Global Economic Model Intercomparison

## Literature

**Shared socio-economic pathways** (contact F. Piontek, PIK)

Moss et al. 2010: The next generation of scenarios for climate change research and assessment

Kriegler et al. 2010: Socio-economic Scenario Development for Climate Change Analysis

Arnell et al. 2011: A framework for a new generation of socio-economic scenarios for climate change impact, adaptation, vulnerability, and mitigation research (framework paper draft)

Van Vuuren et al. 2012: A proposal for a new scenario framework to support research and assessment in different climate research communities

O'Neill et al. 2012: Workshop on the nature and use of new socioeconomic pathways for climate change research (meeting report on storylines)

- Population/GDP/urbanization data: contact Keywan Riahi (riahi@iiasa.ac.at) or Detlef van Vuuren (Detlef.vanVuuren@pbl.nl) – also for any questions on SSPs!
- https://secure.iiasa.ac.at/web-apps/ene/SspDb - Data, further information
- Edenhofer et al. (2012) IPCC Workshop on Socio-Economic Scenarios, 1-3 November 2010. Berlin.
- Joint IAV-IAM Committee - https://www.isp.ucar.edu/joint-iav-iam-committee
- RAPs: contact Delphine Deryng for information (D.Deryng@uea.ac.uk). Presentation by John Antle (2011).

**Climate and weather generators** (contact M. Semenov, Rothamsted)

Calanca P & Semenov MA (in press) Local-scale climate scenarios for impact studies and risk assessments: integration of early 21st century ENSEMBLES projections into the ELPIS database *Theoretical and Applied Climatology*, (doi: 10.1007/s00704-012-0799-3).

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## Acronyms

| | |
|---|---|
| GCM | Global Climate Model/Global Circulation Model |
| SSP | Shared Socio-economic Pathway |
| RCP | Representative Concentration Pathway |
| RAP | Representative Agricultural Pathway (rRAP: regional …) |
| SPA | Shared climate Policy Assumptions |
| SRES | IPCC Special Report on Emission Scenarios |
| CMIP5 | Coupled Model Intercomparison Project Phase 5 |

## Appendix: Agenda

| | | |
|---|---|---|
| We, 5 June | [Live-broadcast via WWW] | |
| 12:30 | *Lunch* | |
| 14:00 | Welcome | M. Banse |
| 14:15 | Overview: Climate scenarios | M. Semenov |
| 15:15 | *Break* | |
| 15:45 | Overview: Shared Socio-economic Pathways | F. Piontek (PIK) |
| 16:45 | What climate (change) and socioeconomic issues are important for each Theme? What information is required from the other Themes? (20 min presentation + 10 min discussion) | TradeM |
| 17:15 | | CropM |
| 17:45 | | LiveM |
| 18:15 | *End* | |
| Th., 6 June | | |
| 8:30 | Ultra-short presentation of linked models (3 min each) | |
| 9:30 | Agreement on concrete questions | M. Köchy |
| 10:30 | Specification of major scenario dimensions (EU policy, GHG reduction, adaptation, biofuel, crop rotation) | |
| 12:00 | *Lunch* | |
| 15:30 | Selection of pilot regions | M. Köchy |
| **13:00** | Selection of socio-economic scenarios | M. Köchy |
| 14:30 | Selection of joint climate scenario(s)[MK4] | |
| 16:30 | Implementation: data exchange, scheduling, stakeholders, evaluation, responsible persons, scaling, etc. | J. Jorgensen, M. Köchy |
| 18:00 | *End* | |
| Fr., 7 June | | |
| 8:45 | •Continue from day before<br>•Mid term-results (April 2014) should include first integrated results and a 1960-1990/baseline for each regional pilot study<br>•Involvement of agricultural insurances, re-insurances | M. Köchy |
| 10:30 | Time for Themes, WPs, Tasks, or Cross-Theme groups | |
| 12:00 | *End* | |